21. (New) A micro-electro-mechanical component formed of silicon, the component comprising
a feature on the component which is subjected to a mechanical stress, and
a coating on the feature to increase the robustness thereof, the coating comprising a ductile metal.

22. (New) The micro-electro-mechanical component of claim 21 further comprising a seed layer to facilitate the ability of the metal to coat the feature.

23. (New) The component of claim 22 wherein the armored coating has a thickness of about 10 microns.

24. (New) The micro-electro-mechanical component of claim 21 wherein the ductile metal coating the feature prevents the silicon from chipping or breaking near the feature which is subjected to a mechanical stress.

25. (New) The micro-electro-mechanical component of claim 21 wherein the coating comprising a ductile metal coats substantially the entire surface of the component.

REMARKS

This is in response to the Office Action dated November 13, 2002, in which claims 1-20 were rejected under 35 U.S.C. § 103(a). With this Amendment, new claims 21-25 are added, and the Specification and Drawings are amended.

Amendment to Specification

At the request of the Examiner, the specification has been proofread again for errors. With this Amendment, the specification has been amended to correct typographical errors. In addition, the paragraphs at page 3, lines 6-17 have been amended to clarify that the slider is not

shown in FIG. 1. Instead, FIG. 1 shows a platform 20 (see corrected drawing) onto which a slider can be placed.

Drawing Objection

The drawings were objected to because FIG. 1 did not show the "slider 20." FIG. 1 has been corrected to clarify that a platform 20 is shown onto which a slider can be placed. Enclosed is a corrected formal drawing of FIG. 1, along with a letter to the Official Draftsman.

Claim Rejections - 35 U.S.C. § 103

Claim 1 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Sato et al. (U.S. Patent No. 5,869,758) and claims 1-20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hetrick et al. (U.S. Patent No. 6,404,028). The Examiner states that Sato et al. discloses a microelectromechanical component formed of silicon that includes a feature that is subjected to a mechanical stress, and torsion bars operating as the elastic supporting portion of the feature. The Examiner concludes that it would have been obvious to one of ordinary skill in the art that the torsion bars include means for increasing robustness.

The Examiner then states that the Hetrick et al. patent discloses a microelectromechanical component formed of silicon having a feature that is subjected to a mechanical stress and a ductile material coating the feature to prevent sticking of the feature to the substrate. The examiner concludes that it would have been obvious to one of ordinary skill in the art that the ductile material can increase robustness of the micro component.

As disclosed in the specification, the present invention recites "a method of increasing the robustness of micro components formed of silicon." (P. 1, ll. 8-9.) Silicon has become the industry standard material for forming micro components. Silicon is a hard brittle material that is very susceptible to chipping, cracking, and breaking. (P. 1, ll. 12-14, and P. 2, ll. 1-2.) When handling a MEMS device made of silicon, the MEMS device will typically come into contact with such traditional tools as tweezers, robot pick and place tools, and pin contacts. Any time the silicon

MEMS device is contacted by one of these tools, stress concentrations at the location of contact may be created. These locations are very susceptible to chipping, cracking, or even breaking due to the increased stress concentrations. (P. 1, l. 25 - P. 2, l. 2.)

To solve this problem, the present invention provides a ductile coating, such as a metal, that can absorb the stresses applied to a feature on a MEMS device. This coating serves to absorb the stress of repeated contact and prevents the stress from being transferred through the ductile material, thereby reducing or eliminating the problems of chipping, cracking, and breaking and increasing the robustness of the feature of the MEMS device. (P. 4, ll. 16-20.)

Accordingly, independent claim 1 recites a microelectromechanical component formed of silicon, the component comprising a feature on the component which is subjected to a mechanical stress; and means for increasing robustness of the feature.

As disclosed in the specification, the robustness of the feature is increased "so that there is less breakage and less contamination caused due to chipping, cracking, or breaking." (P. 2, ll. 12-14.) The present invention is not obvious in light of Sato et al. or Hetrick et al. There is no teaching, suggestion, or motivation present in either the Sato et al. patent or the Hetrick et al. patent to form a microelectromechanical component that includes a means for increasing robustness.

The Sato et al. patent does not teach increasing the robustness of a microelectromechanical component. Rather, Sato et al. teaches directly away from this by teaching a method of eliminating contact with the test piece. The Sato et al. patent does recognize the problem of silicon being a brittle material that can easily be destructed when it comes in contact with a tensile tester. (Col. 1, ll. 41-48.) Rather than attempting to increase the robustness of the silicon test piece, the Sato el al. patent solves the problem by designing a test system with no direct contact to the test piece. (Col. 1, ll. 60-63.) Because there is no direct contact between the test piece and the tester, the test system does not experience the problems of chipping, cracking, and breaking. (col. 2, ll. 10-14.)

Therefore, the Sato et al. patent solves the problem of chips and cracks in silicon structures in a completely different way than the present invention. Rather than increasing the

robustness of a test piece, the Sato et al. patent teaches a method of eliminating the contact between the tester and the test piece. Because Sato et al. teaches eliminating contact to avoid chipping and cracking the silicon, it is not obvious to one skilled in the art to increase the robustness of the test piece of the Sato et al. patent. Increasing the robustness is unnecessary because the problem of chipping and cracking has been solved by ensuring that the test piece does not come in direct contact with a tester

Similarly, the Hetrick et al. patent does not teach increasing the robustness of a feature. The Hetrick et al. patent discloses the use of an amorphous hydrogenated carbon (AHC) coating on microelectromechanical structures (MEMS) to reduce the adhesive forces between micro structure surfaces. (Col. 3, ll. 3-11.) The preferred material for the AHC coating is Si-AHC. (Col. 4, ll. 18-24.) This AHC coating provides a high hardness and high Young's modules, which also makes AHC a good material for mechanical structures of the MEMS. (Col. 3, ll. 47-55.) While there are a number of benefits of the AHC coating disclosed, the Hetrick et al. patent does not disclose the AHC coating as being a ductile material that is able to absorb stress and increase robustness

"Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art." See MPEP 2143.01. Thus, there must be some teaching in Hetrick to use a ductile coating to increase robustness. However, there is no teaching that an AHC coating can be used to increase robustness. Rather than teaching that the AHC coating improves the robustness, the Hetrick et al. patent teaches that the AHC coating decreases adhesive forces and provides low friction and wear by forming a hydrophobic surface. (Col. 3, ll. 3-11 and col. 4, ll. 5-10.)

No combination of the Sato et al. patent and the Hetrick et al. patent teach or suggest increasing the robustness of a MEMS device. As such, independent claim 1 is in condition for allowance.

Independent claims 6 and 12 recite a coating to increase the robustness of an area of a micro component. As previously described, the Hetrick et al. patent does not teach increasing the robustness of a micro component. Therefore, independent claims 6 and 12 are also in condition for allowance.

Dependent claims 2-5, 7-11, and 13-20 depend from independent claims 1, 6, and 12 respectively, and are allowable therewith. In addition, it is respectfully submitted that the combinations of features recited in claims 2-5, 7-11, and 13-20 are patentable on their own merits, although this does not need to be specifically addressed herein since any claim depending from a patentable independent claim is also patentable. *See* MPEP 2143.03 (citing *In re Fine*, 5 U.S.P.Q. (BNA) 1596 (Fed. Cir. 1988)).

Also with this Amendment, new claims 21-25 have been added. New claims are more specifically directed to coating a feature on the MEMS component with a ductile metal to increase the robustness of the feature on the component which is subjected to a mechanical stress. Because no combination of the Sato et al. patent or the Hetrick et al. patent teach or suggest coating a feature on the component with a ductile metal, new claims 21-25 are in condition for allowance.

Based on the above Amendment and discussion, reconsideration and allowance of all pending claims 1-20 and 21-25 is respectfully requested. The Commissioner is authorized to charge payment of any patent application processing or filing fees under 37 C.F.R. 1.16 and 1.17 or credit any overpayment to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

Date: 5-13-03

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APPENDIX:
MARKED UP VERSION OF SPECIFICATION AND CLAIM AMENDMENTS

IN THE SPECIFICATION

Please amend the paragraph at page 3, lines 6-12 as follows:

Figure 1 is a top plan view of a silicon MEMS device useful in testing sliders. Shown in Figure 1 is a MEMS device 10 comprising an outer frame 12, several inner springs 14, two circular pin holes 16, [and] a tab 18, and a pedestal 20. The MEMS device 10 functions as a clamp for holding a slider [20] during testing. The slider [20] can be temporarily clamped [in] into the MEMS device 10 on pedestal 20 so that the slider [20] can be flown above a disc, tested, unclamped, and then removed from the MEMS device 10.

Please amend the paragraph at page 3, lines 13-17 as follows:

The pin holes 16 on the MEMS device 10 align and hold the device 10 on a suspension or fixture (not shown in Figure 1). The tab 18 provides a location at which pressure can be applied to the MEMS device 10. When pressure is exerted on tab 18, the springs 14 deform to open the clamp and allow the slider [20] to be inserted or removed from pedestal 20 of the MEMS device 10.

Please amend the paragraph at page 4, lines 12-21 as follows:

Any time the MEMS device 10 is chipped or cracked, small amounts of silicon may contaminate the slider held in the MEMS device 10 or may contaminate the disc or other electrical components near the device MEMS 10. Furthermore, cracks in the MEMS device 10 can develop into more serious structural flaws or even breaks. To overcome the chipping and breakage problem, the present invention involves coating the MEMS device 10 with a ductile material, such as a metal, to prevent and reduce chipping and breakage. This armored coating serves to absorb the stress of repeated contact and prevents the stress from being transferred through the ductile material to the silicon crystals so that the silicon [either] neither fractures, breaks, or chips.

Please amend the paragraph at page 5, lines 1-9 as follows:

Figures 2A-2B are simplified cross-sectional views of a wafer illustrating the process flow for providing [a] micro components with a total armored coating. Shown in Figure 2A is a wafer substrate 30. In the first step of providing the wafer 30 with armored coating, a conformal coating of a seed layer 32 is deposited on the wafer substrate 30. Any suitable seed layer material may be used, such as Tantalum. In depositing the seed layer 32, it is desirable for the seed layer 32 to be very thin. Typically, the seed layer 32 is sputtered on and is about a few thousand Angstroms thick. The seed layer provides a surface onto which a ductile metal can be deposited.

Please amend the paragraph at page 5, line 27 - page 6, line 5 as follows:

The type of metal chosen as well as the method of depositing it on the wafer 30 may depend on the geometric factors of the features on the wafer 30. In particular, for a MEMS device having intricate or fine geometric features, CVD may provide the best deposition method. A CVD process is particularly suited for [in] instances where the coating 34 must evenly [coated] coat very small areas, deep recesses, and other features found in connection with intricate geometries. For devices having more coarse features, electroplating or sputtering may be suitable.

APPENDIX:
MARKED UP VERSION OF SPECIFICATION AND CLAIM AMENDMENTS

Please amend the paragraph at page 6, lines 17-23 as follows:

Figure 3A shows a wafer 40 and an area 42 of the wafer 40 to which it is desired that the armored coating be applied. The first step of applying a partial armored coating to the wafer 40 is shown in Figure 3B. Figure 3B illustrates applying photo resist 44 to [he] <u>the</u> wafer 40 on all areas of the wafer 40 but the area [40] <u>42</u> which is to be armor coated. Next, as shown in Figure 3C, a seed layer 46 is deposited on the wafer 40. The seed layer 46 covers both the photo resist 44 as well as the area [40] <u>42</u> to be armor coated.